ORAL CONTRIBUTIONS

840 Adult Congenital Heart Disease

Tuesday, March 09, 2004, 10:30 a.m.-Noon
Morial Convention Center, Room 260

10:30 a.m.

840-1 Myocardial Fibrosis Patterns Correlate With Adverse Right Ventricular Morphology and Function in Patients With Repaired Conotruncal Heart Defects

Anne Marie Valente, Salim F. Idriss, Peter Cawley, John Heitner, Igor Klem, Jospeh Kay, Ann Marie Nawrocki, Michele Parker, J. Rene' Herlong, Raymond Kim, Duke University Medical Center, Durham, NC

Background: Repair of tetralogy of Fallot (TOF) and transposition of the great arteries (TGA), the most common conotruncal congenital heart defects, often results in right ventricular (RV) volume and/or pressure overload. RV failure often ensues over time. Myocardial fibrosis may be an important correlate of RV dysfunction and adverse RV remodeling. Delayed contrast enhancement cardiac MRI (DEMRI) is known to be a sensitive technique for determining the presence, location and extent of myocardial fibrosis in vivo. The purpose of this study was to correlate the presence, location and extent of myocardial fibrosis on DEMRI with RV volumes and function, as well as QRS duration in patients with repaired TOF or TGA.
Methods: Twenty seven patients with TOF or TGA were prospectively identified and underwent cine and DEMRI. Measurements of RV morphology and function were assessed on the cine images, and the extent of hyperenhancement (HE) was assessed on delayed enhancement images. QRS duration was measured from the standard electrocardiogram.
Results: All patients, regardless of RV size and function, had evidence of some myocardial fibrosis as determined by the presence of HE. However, there was a predilection of myocardial fibrosis for specific locations. In particular, the junction of the RV freewall with the interventricular septum was commonly involved (100% at the inferior septal junction, 56% at the anterior septal junction). Six patients (22%) had direct involvement of the right ventricular free wall. The extent of HE correlated with RVEDV and RVESV ($p<0.01$). In addition, QRS duration correlated with RVEDV, RVESV, and RVEF ($p<0.05$, all).
Conclusion: Patients with repaired conotruncal congenital heart defects such as TOF and TGA have areas of myocardial fibrosis that are located remote from sites of direct surgical intervention. The concentration of myocardial fibrosis in these unexpected locations remains to be explained. The extent of fibrosis in these patients and QRS duration correlates with adverse right ventricular morphology and function. Future investigations of the relationship between right ventricular fibrosis characteristics and outcomes in this patient population are necessary.

10:45 a.m.

840-2 Mismatch of the Coronary Circulation: Impact on the Systemic Right Ventricle

Michael Hauser, Heiko Stern, Frank Bengel, Sohrab Fratz, Alfred Hager, Stefan Nekolla, Harald Kaemmerer, Markus Schwaiger, John Hess, German Heart Centre Munich, Munich, Germany, Nuklearmedizinische Klinik der TU-Munich, Munich, Germany

Background: Ventricular dysfunction of the systemic right ventricle (RV) is evident in at least 10% of patients at 10 years and may be caused by a mismatch between O2 demand and supply.
Methods: We investigated 20 patients (22.7 SD 4.9 yrs) with TGA after atrial repair (ASO) and 15 patients (30.6 SD 16.4 yrs) with unoperated congenitally corrected transposition (CCTGA); 11 normals (26.2 SD 5.2 yrs) served as controls for the myocardial blood flow (MBF). All patients had spiroergometry, MRI and positron emission tomography (NH3, rest / Adenosine); all ASO patients additionally had cardiac catherization.
Results: MBFrest did not differ between patients with ASO, CCTGA and controls, whilst MBFstress (ASO 167 SD 46* vs. CCTGA 198 SD 38* vs. controls 310 SD 74 ml/100g/min.; $p<0.001$) and coronary flow reserve (ASO 2.3 SD 0.4* vs. CCTGA 2.6 SD 0.6* vs. controls 4.1 SD 0.7; $p<0.001$) were significantly reduced; angiography did not show any stenosis of the coronary arteries, suggesting microvascular disease. In both patient groups a negativ correlation between ventricular mass and MBFrest could be calculated. In CCTGA there additionally was a significant correlation between CFR and the increase of the systolic function after dobutamine administration on MRI ($r=0.71$; $p<0.01$), BNP-levels ($r=0.69$; $p<0.01$) and VO2 max. ($r=0.62$; $p<0.01$). In patients with ASO, CFR is not significantly correlated with ventricular function, BNP and VO2 max, suggesting a multifactorial process (attenuated atrial compliance with reduced preload).
Conclusion: The intrinsic geometry of the systemic RV and the process of remodelling (myocyte hypertrophy and disarray, interstitial fibrosis, inadequate capillary growth, thickening of the media of intramural coronary arteries) may contribute to limited nutritional support with ventricular deterioration and electrical instability; the mismatch between O2 demand and supply is an important risk factor for the long-term prognosis of patients with morphologic right ventricle; in patients with TGA after atrial repair it is at least one important cofactor causing ventricular deterioration.

11:00 a.m.

840-3 Bicuspid Aortic Valve in Athletes: An Underestimated Problem?

Giorgio Galanti, Marta Rizzo, Paolo Manetti, Valentina Di Tante, Alfredo Guerrisi, Maria Concetta Robertina Vono, Jacopo Giuliattini, Loira Toncelli, University of Florence, Florence, Italy

Background. Bicuspid aortic valve (BAV) is likely to be a common cardiac disease in athletes, however to date, limited data are available. The great concern of sports medicine physicians for BAV is related to the valvular and vascular complications characterizing the natural history of disease which are likely to be accelerated or worsen by athletic training.
Object. The present investigation was designed to evaluate the prevalence of bicuspid aortic valve (BAV) among a large group of unselected, competitive asymptomatic athletes and the prevalence and the extent of associated complications, compared to those reported in community-based studies.
Method. In a 3-years period, 2273 (788 F and 1485 M) consecutive competitive athletes aged 8 to 60 years (average: 31±11.3 years), representing 16 different sports were evaluated by Echocardiography (Echo). Echo measurements included aortic root dimensions at four levels: aortic annulus, sinuses of Valsalva, sinotubular junction and proximal ascending aorta.
Results. BAV was diagnosed in 58 athletes, corresponding to a prevalence of 2,55%, significantly greater than prevalence reported in population-based studies.
BAV was normally functioning in only 9 athletes. Aortic regurgitation was detected in the other 49 athletes. It was mild in 14 athletes, moderate in 27 and moderate-to-severe in 8. A moderate aortic stenosis was documented in two athletes.
Aortic root dimensions at all the measured levels were significantly larger in athletes with BAV than in athletes with tricuspid aortic valve. Aortic dilatation was not associated with age, body surface area, presence and extent of aortic regurgitation, nor with the years of training.
15 BAV athletes were disqualified from competition because severe aortic regurgitation associated to left ventricular dilatation or aortic dilatation, independently from valvular functioning.
Conclusions. The results of this investigation highlights on the high prevalence of BAV and its complications in athletic population and suggest the importance of strongly support the implementation of pre-participation screening with echocardiography

11:15 a.m.

840-4 Failing Fontan Circulation Necessitating Transplantation: A Clinicopathologic Correlation

Fotios A. Mitropoulos, Hillel Laks, Jacques Neelankavil, Juan Alejos, John S. Child, Vivek Allada, Stacey Drant, Jon Kobashigawa, Jonah Odim, Michael Fishbein, Mark Plunkett, UCLA Medical Center, Los Angeles, CA, Mattel's Childrens Hospital, Los Angeles, CA

Background: Some patients with Fontan palliation for univentricular congenital heart disease will eventually fail and require orthotopic heart transplantation (OHT).This particular mode of cardiovascular failure has been investigated in the past focusing primarily on the Fontan pathway and its obstruction. We sought to describe and define the clinical-pathologic events that occur in the univentricular heart.
Methods: We retrospectively analyzed the data from 31 patients (19 males and 12 females) with Fontan physiology who underwent OHT at a mean age of 17 years (range, 7-48) with special emphasis on the pathological changes of the explanted heart.
Results: All 31 patients were in NYHA class III or IV, and 14/31 required pacemaker therapy for arrhythmias (10/14 atrial dysrhythmias, 1/14 junctional bradycardia, 2/14 ventricular tachycardia, and 1/14 sick sinus syndrome). The mean Fontan pressure was 24.5 mmHg (range, 7-26). Echo data available in 24/31 revealed a mean ejection fraction of 23% (range, 10-45). In 19/24 patients atrioventricular valve regurgitation was moderate to severe in 11/19 and mild in 7/19. Mean heart weight was 371g (range, 120-880). The mean percentage of hypertrophy based on the patient's height was 156% (range, 60-436). Microscopically, fibrosis was present in all but one explanted heart: 10/31 had interstitial fibrosis, 13/31 had replacement fibrosis, 7/31 had both, and 1/31 had myocardial fibroelastosis. The mean free ventricular wall thickness was 1.75 cm (range, 1.0-3.2).
Conclusion: Failing univentricular hearts with Fontan circulation demonstrate similar clinicopathologic changes to the biventricular hearts that fail. These findings argue for routine anticongestive medical therapy post-Fontan to delay and/or prevent adverse remodeling and failure of the univentricular heart. A prospective trial is proposed to address this issue.

11:30 a.m.

840-5 Should Mechanical Valves Be Used in the Pulmonary Position

John M. Stulak, Heidi M. Connolly, Francisco J. Puga, Joseph A. Dearani, Carole A. Warnes, Hartzell V. Schaff, Mayo Clinic, Rochester, MN

Objectives: Bioprostheses are the most commonly used valve substitutes in the pulmonary position, but most require late re-replacement. Mechanical valves may have better durability, but there are conflicting reports regarding late outcome of these prostheses for pulmonary valve replacement (PVR).
Methods: We reviewed 10 patients (pts) (27 +/- 12 years (yrs)) who underwent mechanical PVR between January 1969 and June 2002. Diagnoses included carcinoid heart disease (n=4), double outlet right ventricle (n=2), pulmonary stenosis/atresia (n=2), transposition of the great arteries (n=1), and truncus arteriosus (n=1). Eight had PVR at our institution and 2 pts underwent PVR elsewhere.

Results: Indications for PVR were valvular regurgitation (n=6), obstruction (n=3), and both (n=1). Valve types were St. Jude (n=7), Starr-Edwards (n=2), and Bjork-Shiley (n=1). In 5 pts, the mechanical PVR was placed within a conduit. Concomitant mechanical tricuspid valve replacement (St. Jude) was performed in 6 pts. Postoperatively, all but 1 were anticoagulated with warfarin. During late follow-up (8.3 +/- 7.7 yrs, max 25 yrs), 1 pt required repeat PVR for outgrowth of prosthesis 25 yrs postoperatively, and 1 pt with normal prosthetic pulmonary valve function underwent heart transplantation for severe biventricular failure 3.5 yrs postoperatively. The average mean gradient across the mechanical PVR by echocardiography in the remaining 8 pts was 11 +/- 7 mmHg. There were no perivalvular leaks or vegetations, and no evidence of pannus formation or prosthesis dysfunction. There were 3 late minor bleeding events (epistaxis in 2 pts and menorrhagia in 1). There was 1 sudden late death 15 yrs after PVR, and 1 death from unknown causes in the aforementioned pt with outgrowth of the mechanical PVR, 5.5 yrs post re-PVR with a bioprosthesis. There were no cases of pulmonary emboli or PVR thrombosis.
Conclusions: Mechanical PVR appears to provide excellent durability and hemodynamic results without mechanical valve failure or valve thrombosis in this small series. Mechanical prostheses should be considered for PVR in selected pts, particularly those who require chronic warfarin anticoagulation for other reasons.

11:45 a.m.

840-6 Coarctation Long-Term Assessment (COALA-Study) Incidence of Restenosis and Hypertension After Surgical Repair

Alfred Hager, Simone Kanz, Harald Kaemmerer, Christian Schreiber, John Hess, Deutsches Herzzentrim München, TUM, München, Germany

Background: to assess the incidence of restenosis and arterial hypertension in patients after surgical repair of aortic coarctation in a cross sectional study.
Patients and Methods: From 1974 to now 405 patients born before 1.1.1965 underwent surgery for isolated aortic coarctation in our hospital. From those 383 who are still alive 26 moved to remote or unknown areas and 83 denied a follow up examination at our institution. The study group of the remaining 274 patients (16 - 73 years old, 90 female, 184 male, 72% of those that are still alive), 18.4 ± 5.9 years (range 1 - 27 years) after surgery, underwent a structured clinical investigation with a Doppler sonographic measurement of the blood pressure at all limbs, exercise test, and ambulatory blood pressure measurement.
Results: 29 patients (11%) already underwent surgery for restenosis, another 20 patients (7%) had a leg-arm gradient of more than 20 mmHg suggesting restenosis now. Risk factors were young age at the first repair and first repair without end-to-end anastomosis.
67 Patients (24%) were already on antihypertensive drug therapy, another 48 patients (18%) had a mean systolic blood pressure of 134 mmHg or higher in ambulatory blood pressure measurement and should therefore also be classified hypertensive. Furthermore, another 28 patients (10%) showed a blood pressure during exercise exceeding 2 SD of reference values. All in all, only 131 patients (48%) had a normal blood pressure reaction. The only independent risk factors for an abnormal blood pressure was a repair without end-to-end anastomosis. Other risk factors like age at repair, age at investigation, and body weight at investigation were not significant in a multiple regression analysis anymore.
Conclusions: In the long-term follow up 18% of patients after surgery for aortic coarctation show restenosis. An arterial hypertensive blood pressure reaction is much more common in long term follow up with an incidence of 52%. In only few patients hypertension is due to restenosis. Best results were achieved in patients in whom an end-to-end anastomosis could be performed and in whom repair was not performed at a very young age.

POSTER SESSION

1152 Heart Failure, Exercise, and Risk Factors in Congenital Heart Disease

Tuesday, March 09, 2004, Noon-2:00 p.m.
Morial Convention Center, Hall G
Presentation Hour: 1:00 p.m.-2:00 p.m.

1152-199 Thromboembolic Events Among Children With Cardiomyopathy: Results From the National Australian Childhood Cardiomyopathy Study

Robert G. Weintraub, Patty Chondros, Alan Nugent, John Carlin, Piers E.F Daubeney, National Australian Childhood Cardiomyopathy Study, Melbourne, Australia

Background: Subjects with cardiomyopathy (CM) are at risk from thromboembolism. There is little information about predisposing factors and the magnitude of the risk in children.
Methods: The National Australian Childhood Cardiomyopathy Study is a population-based study, including all children in Australia with primary CM who presented at 0-10 years of age. Cases were classified according to WHO criteria. A thromboembolic event was defined as the finding of intracardiac thrombus, or onset of organ dysfunction related to an embolic event. Risk factors examined included CM type, congestive heart failure (CHF) at diagnosis, duration of inotropic therapy, mechanical ventilation, ICU and hospital stay at presentation. Children not surviving 24 hours from presentation were excluded from survival analysis. Study end-points were death or transplantation.
Results: There were 314 patients diagnosed with CM during the study period, of which 299 were included in survival analysis. Of these, 19 (6.4%) of these developed thromboembolic complications, including 14/172 (8.1%) with dilated CM, 3/39 (7.7%) with unclassified CM, 1/12 (8.5%) with restrictive CM and 1/80 (1.2%) with hypertrophic CM (p=0.02 compared to other cases). 6 of 19 (31.6%) of thromboembolic events occurred <2 days of presentation and 14 (73.7%) occurred <30 days. CHF at presentation was related to risk of thromboembolism (hazard ratio 5.0; 95% CI: 1.6-21.8). The one and 5-year survival free from thromboembolic events were 93% (95% CI: 89-96%) and 91% (95% CI 84-95%), respectively, for children with dilated CM, and 92% (95% CI: 76-97%) at both time points for children with unclassified CM. Embolic phenomena included a cerebrovascular event in 5 cases and a pulmonary embolus in 1. The risk of death or transplantation was significantly increased for all study patients with thromboembolism (hazard ratio 4.2; 95%CI: 1.6-11.2) as well as for those with dilated CM alone (hazard ratio 4.6; 95% CI: 1.45-14.6).
Conclusions: Thromboembolism occurs in up to 9% of children with CM within one year of diagnosis and is related to early CHF and CM type. Thromboembolic complications occur early and are associated with an increased risk of death or transplantation.

1152-200 N-Terminal Pro-B-Type Natriuretic Peptide Differentiates Lung From Heart Disease in Infants With Respiratory Distress

Shlomo Cohen, Chaim Springer, Zeev Perles, Azaria JJT Rein, Avraham Avital, Zvi Argaman, Amiram Nir, Hadassah University Hospital, Jerusalem, Israel, Shaarei Zedek Medical Center, Jerusalem, Israel

Background: Respiratory distress (RD) is a common symptom in infants. RD is usually caused by lung disease, but can also be a result heart disease. It is often difficult do determine the cause of RD. N-terminal pro-B-type natriuretic peptide (N-BNP) is co-secreted along with BNP from cardiac myocytes. Like BNP, N-BNP is a marker for cardiac volume and pressure overload.
Aim: To determine whether N-BNP levels can differentiate between lung disease and heart disease in infant with RD.
Methods: Infants (age 1-36m) who presented at Hadassah University Hospital with RD underwent physical examination, chest X-ray, arterial blood gases and echocardiogram. Control N-BNP values were obtained from age-matched babies with no acute illness and no history or signs for heart or lung disease. Plasma N-BNP levels were measured by Electrochemiluminescence immunoassay (Roche, Germany).
Results: There were 18 infants with lung disease (laryngitis, pneumonia and RSV bronchiolitis), 19 infants with heart disease (myocarditis, dilated cardiomyopathy, atrio-ventricular canal, hypertrophic cardiomyopathy and ventricular septal defect) and 16 healthy infants. Infants with respiratory distress due to heart disease had significantly higher plasma N-BNP than infants with respiratory distress due to lung disease or control (table).
* p<0.001 vs lung and vs control; # p<0.05 vs control.
Conclusions: Plasma N-BNP can differentiate infants with RD due to heart disease form infant with RD due to lung disease.

Group	Number	Age-months mean(±sd)	Respiratory rate mean(±sd)	O_2 saturation mean(±sd)	N-BNP (pg/ml) median
Control	16	14.3(5.4)	36(7.8)	97(1.4)	164
Lung	18	9.2(5.9)	62(16.1)#	89.4(3.7)#	311
Heart	19	11.9(12.3)	68(15.7)#	88.6(4.7)#	15403*

1152-201 Brain Natriuretic Peptide Correlates With Myocardial Performance Index in Congenital Heart Disease Patients

Alice A. Perlowski, John S. Child, Robert S. Ross, Pamela D. Miner, David Geffen School of Medicine-UCLA Medical Center, Los Angeles, CA

Background: The myocardial performance index (MPI) is an echocardiographic Doppler-derived measure of ventricular function that has been previously validated in congenital heart disease(CHD) patients. It may be preferred over conventional non-invasive measures of ventricular function in patients with complex anatomy, since it is neither dependent on geometric shape nor heart rate. Although Brain Natriuretic Peptide (BNP) is well described as a predictor of systolic and diastolic dysfunction in anatomically correct hearts, it is unclear how it relates to MPI in those with CHD.
Methods: We prospectively evaluated 54 adult patients with a broad range of both cyanotic and noncyanotic heart disease. Included were both surgically repaired and unrepaired pts. Levels of BNP were measured in all subjects using standardized assays. Doppler echocardiography was performed on the study subjects within six months of the BNP assay. No subject had a change in functional clinical status during this interval. Echo images were evaluated by an experienced observer blinded to BNP results and clinical status. The MPI was calculated as the interval from AV valve closure to opening minus ventricular ejection time, divided by ventricular ejection time. EF was calculated with standard methodology by the same observer.
Results: Of a total of 54 patients with measurable left ventricular (LV) or univentricular (UV) EFs, 34 had adequate data to calculate LV or UV MPIs. Of 30 pts with measurable right ventricular (RV) EFs, 23 had adequate data to calculate RV MPIs. BNP was found to be significantly correlated with LV/UV MPI (r= 0.461 with p= 0.006)and RV MPI (r= 0.748 with p < 0.0001) while LV/UV EF and RV EF had no significant correlation with BNP (r= -0.189, p= 0.172; r= -0.066, p= 0.729, respectively) using a Pearson's correlation coefficient test.
Conclusion: In patients with CHD, BNP correlates significantly with MPI but not with left, right, or univentricular EF. This appears to be particularly true in the case of geometrically